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A First Step in the Solution of a Potato Problem

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The cultivated potato, Solanum tuberosum, has been subject to serious diseases almost from the beginning of commercial culture in Europe and North America. The literature of the eighteenth and nineteenth centuries is full of references to a degeneration or running out of varieties, to a disease called curl by the English, to tuber rot, and finally, to blight and rot. The curl was found to be a degenerating disease and for many decades this disease was considered to be a degeneration brought about by continued asexual propagation. The remedy consisted in developing new varieties from true seeds or of bringing in new stock from the ancestral home of the potato. Either method seemed to give temporary relief but it is significent that a system of tuber testing which was developed very early seems to have given equally as good results in reducing the incidence of this disease. Some of the descriptions of curl indicate that the disease was the same as our present-day leafroll and others that it corresponds to mosaic. It is likely that both diseases were involved. That the curl is a communicable disease was demonstrated over a century ago but the degeneration theory nevertheless had a preponderance of advocates down to the time of the outbreak of blight and during the 15 subsequent years that scientists groped for the cause of this new trouble. Chauncy Goodrich of Utica, N. Y., believed firmly in the degeneration theory and it was on this basis that he began the importation of "new blood" in his efforts to combat the blight and rot.

At the present time almost everyone believes that running out is due to a specific disease which is communicable; and the cause of blight was ascribed by Anton deBary in 1861 to a fun-

gus, Phytophthora infestans, since which time there has been no controversy about the cause of this disease. The origin of these diseases, however, is as yet unknown. It is easy to believe that since the virus diseases as well as blight and various tuber decays are transmitted in the tubers, that the diseases were introduced in tubers imported from South America. No positive records seem to exist regarding the occurrence of any of these diseases on wild plants or on the semi-domesticated varieties of the South American Indians. This situation may be explained very easily by saying that no one familiar with the diseases ever has gone to the wild to look for them. This is really a very important point to settle if such a thing is possible. It is easy to see that potato diseases and particularly those of the destructive type like virus diseases or blight, if they existed in the ancestral home of the potato would long since have destroyed and effaced from the earth any plants that are as susceptible to them as our present-day varieties. Either these wild plants have undergone a natural selection, the fittest only surviving at the present time, or else the diseases do not exist there except as they may have been carried in on cultivated potatoes introduced from other countries. On the other hand if the diseases have passed to the potato from other solanaceous hosts in Europe and North America the wild plants could not be expected to possess a resistance or immunity to the diseases except as they might possess such a character fortuitously just as certain hot tropical plants apparently possess a fortuitous tolerance for cold. It seems obvious that in either event it is time now that the facts in the matter be ascertained. Progress in plant breeding is such that it is enirely within the realm of possibility to make important improvements in the present-day varieties of potatoes by introducing into them the blood of disease-resisting or immune sorts.

There is every reason to believe that the name "tuberosum" does not apply to a species of plant in the biological sense, that the plant originally described under this specific name was, in fact, hybrid in nature, that more than two wild plants are now represented in the composite which we call "the potato" and that it is futile to search anywhere for a wild tuberosum.

A beginning has been made on the very large problem involved by an exploration conducted during the months of August to December 1930 by the Office of Foreign Plant Introduction of the U. S. Department of Agriculture. Paul Russell and Max J. Souviron began the search in the highlands of Mexico on August 1 and Russell was succeeded by the writer on October 1. Before going to Mexico all available specimens of tuberous solani were examined in the herbaria of the University of Vermont (Pringle Herbarium), New York Botanical Garden and the National

Museum and a list of species reported from Mexico was compiled with localities where found. Over 30 species have been reported from the country and this number does not include the numerous sub-species, varieties and forms proposed by the late Professor Bitter nor the species that are about to be described by Bukasoff and his associates in Leningrad. Some of the species have not been reported for many years and it is very easy to believe that morelliforme and schenkii, the former found as recently as 1914 and the latter in 1908, will not be found again "in woods below Boca del Monte near Esperanza" in the state of Puebla for the very good reason that the woods have been destroyed by man and the remaining vegetation is rapidly disappearing before the ommipresent goat. The species polyadenium was not found at Zontecomate station, state of Hidalgo as reported by Pringle. This may have been due to the very dry weather which prevailed there as well as in most parts of the republic during the summer of 1930, but the whole area in a radius of several miles from this station is now under cultivation with little chance that this foul-smelling wild potato would be allowed to persist. This species which is so very distinct that it could be easily and unmistakably identified in the field was sought particularly because it usually has been reported from "limestone cliffs," an unusual place for a potato to grow; but it was not encountered.

It was obviously impossible to cover the whole of Mexico in a single season so that the search in 1930 was confined largely to the tierra fria with the most intensive work in the state from which the largest number of species have been reported, namely the state of Mexico. Less intensive search was made in the following states: Morelos, Puebla, Oaxaca (much too dry), Vera Cruz, Hidalgo, Queretaro, Quanajuato, and the Federal District. Living material was desired and in 1930 no ripe seeds of wild potatoes were found prior to October 1 and no tubers that appeared to be mature enough to stand shipment were encountered. In early December it was becoming difficult to find plants because they were already yellowed or entirely gone. At Real del Monte in Hidalgo a frost about November 1 damaged wild potaotes and other herbaceous plants and at Rio Frio, the type locality of demissum, a frost-tolerant and blight-immune species, there was evidence of frost damage on October 8.

In all, seventy different collections of tubers were made and a large collection of seeds. Many of these collections of tubers and seeds were from the same plant but not all of them. The same species was often taken several times from the same general locality for it was noticed repeatedly that plants in one clump might have set seeds abundantly whereas plants not many meters away but apparently of the same species had no seeds at all.

The exact number of species found remains to be determined. Only the more distinctive species could be recognized with any degree of certainty. Many plants had passed the flowering stage and specimens must be grown before specific identity can be established. Five or six species are certainly represented and it is likely that this number will be increased considerably. Even so distinctive a species as demissum is not readily identified in the field. Shade, moisture and competition make a big difference in the general appearance of the plant.

The effect of competition was observed repeatedly. Road building is going on at a rapid rate in the state of Mexico and nearly every road from Mexico City leads over a mountain. It was along these roads that wild potatoes were easiest to find. Almost the first plant to spring up in the "fills" along these roads is the potato; but when one searches for plants above the road near the place from which the earth had been taken, plants are difficult to find and usually are not one-fourth the size of the plants in the "cultivated" ground below the road. In South America the problem of escapes from cultivation arises constantly. This can scarcely be called a problem in the tierra fria. In the five months, August to December, only two small patches of cultivated potatoes were seen.

The data on most herbarium sheets did not prove very helpful in locating wild potatoes, the Pringle labels being a marked exception. Certain records were transcribed, for example, which give the location of the collection as Guanajuato. But the state Guanajuato has an area somewhat greater than that of the kingdom of Belgium! Knowing the field habits of Dr. J. N. Rose made it possible at times to surmise where he might have picked up his specimens. In general, it had to be assumed that collectors visited natural curiosities, churches, mines and the like and with the date of the collection it was often possible to judge where the collector might have gone. On the other hand a label reading "stony hillside, near San Juan del Rio" proved to be very exact. There is only one stony hillside near this place and half way up the hill S. sambucinum was found straggling up through the stones of a fence. Tubers were secured but no flowers or seeds.

The data on elevation are somewhat helpful but many barometers seem not to be reliable and personal estimates with reference to some known elevation apparently fluctuate enormously. Habitat data, on the other hand are very helpful. "In a pine woods" means a great deal. The collections that were made in 1930 were so often from pine woods that in jotting down field notes there appears time after time "under pine tree, as usual." It soon became the habit on going to a new locality to look first for pines or spruces and it even became necessary

to recall to mind from time to time that some species might not tolerate association with these conifers.

A collection which was made not far from Cuernavaca in the state of Morelos showed marked symptoms of blight and the diagnosis was confirmed by microscopic examination. The species on which it occurred has not been identified as yet but tubers on stolons about 1 meter long were secured. This establishes the occurrence of Phytophthora infestans on wild potatoes in Mexico and makes it easier to understand how Solanum demissum may have developed its immunity. Professor Herrera expressed the opinion, orally, that the occurrence of this parasite on wild potatoes in Mexico had been recorded but after some search he was unable to find it. No record is known to the writer.

Constant search was made for the occurrence of virus diseases but no positive records of such diseases were obtained. It is likely that the tubers which are now sprouting in the greenhouse will reveal any such diseases if they were present.

The material secured will be examined not only for the presence of diseases that may have been tuber transmitted but will be tested for susceptibility to the blight and the commoner virus diseases. It is to be presumed that by the autumn of 1931 seeds will be available from most of the collections and that small quantities of such seed can be supplied to those who wish to make tests of any sort. Some of the species can be identified with reasonable certainty as soon as flowers are produced but it is likely that comparisons with types will be necessary in some cases and such studies can not be made before the winter of 1931-32.

A relatively large area was covered in a single short season. This was made possible by the invasion of the automobile. Roads which seemed impassible were negotiated by skillful drivers who had no fears of thorns, stones, ditches, and the like. If this situation could have been anticipated it would have been possible to have made even more extensive explorations by the use of an automobile fitted out for camping. Certain ubiquitous insects make sleep in most of the hotels of the smaller town impossible and one can't tramp the fields all day without refreshing sleep, particularly not at 10,000 feet. Likewise strangers have not time to experiment with unfamiliar foods that are obtainable in the smaller places.

All in all, the first step in the solution of a very large problem of both purely theoretical and extremely practical importance has been made very satisfactorily. The assembling of this material for study has been facilitated by the kindly cooperation of a great many persons in Mexico,—government officials, in-

dividual scientists, and a great many others who had no particular interest in the exploration but who were simply exhibiting an innate friendliness and desire to be helpful to a stranger. To all of them we owe a debt of gratitude which it may be possible to repay in kindness at some future time.

The Relation of Storage Temperature of Potatoes to Their Culinary Quality

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In order to prevent the development of certain diseases and to retard shrinkage and sprouting, low temperatures for potato storage cellars have been generally recommended. Stuart (1) says that while the range of temperatures specified by different investigators varies from 32° to 45° F., most of them recommend temperatures of 33° to 36° F. In northern storage cellars it is easily possible to obtain these temperatures for several months.

The effects of such storage temperatures on culinary quality of potatoes have not been generally recognized, in spite of the fact that the accumulation of sugar that develops under such conditions was pointed out almost fifty years ago. (2) . In the potato there is a continous transformation (1) of sugar to starch, (2) of starch to suger, and (3) of sugar to carbon dioxide and water (the respiration process). Although low temperatures decrease the rate of all of these reactions, the last two are retarded relatively more than is the first. This is the reason for the accumulation of sugar at low temperatures. (2). Hopkins (4) found that at 40° F. the sugar content remains fairly constant. When tubers which have accumulated sugar at temperatures below this are held at higher temperatures, such as 70° to 75° F., the sugar content decreases rapidly by re-transformation to starch and by loss in respiration.

Butler and Morrison (5) studied the effect of storage of potatoes at 32°-41° F. on their cooking quality. They reported that the quality of all potatoes for boiling was much impaired by such storage. When fried, these tubers were inferior to

those held in storage at higher temperatures. They also found that a period of 21 days subsequent storage at 68° gave considerable improvement in the cooking quality. As a result of their experiments, these investigators recommended that potatoes for culinary use be stored in a dry cellar at 46°-50°. More recently, Richardson and Douglas (6) have reported that although storage in a humid cellar at 40° may be desirable for potatoes to be used for seed, storage in a dry cellar at 53°-60° is superior for those to be used for cooking because such tubers are much more mealy.

In experiments at the Maine Agricultural Experiment Station we have found that the accumulated sugar affects frying quality in at least two ways. It causes a sweetness in flavor, and when caramelized during heating, a yellowish or even a dark brown color. The sweetness is evident whatever the method of cooking used. The color change is sometimes noticeable in the cortex of baked potatoes and is always the principal factor determining the browning in the surfaces of fried potatoes. The color of potato chips is correlated with the sugar content of the tubers so that the more sugar present, the darker is the color of the finished product. Since the trade prefers a light straw colored or golden brown chip, potatoes which have been held in low temperature storage may produce unmarketable chips. (7). When the percentage of sugar rises above one-half of one per cent the frying color becomes objectionable. In addition, the degree of caramelization produced by frying thin slices of such potatoes is sufficient to result in a bitter flavor. These high-sugar potatoes also have objectionably dark color when prepared as French fries.

Potatoes grown in the northern states may produce dark chips at the time of harvest. Immature potatoes also contain sufficient sugar (8) to cause them to exhibit this difficulty. Perhaps these facts are related, since potatoes in northern areas are frequently dug while the vines are green.

Warm temperature (68°-70° F.) storage of tubers which have been held under conditions producing sugar accumulation causes them to return to a condition in which the frying color is improved but for chips it remains somewhat uneven, indicating that the sugar does not leave some areas as soon as it does others. The time required for the re-transformation of a part of the sugar to starch and for a conversion of the remainder to carbon dioxide and water depends upon the percentage of sugar at the beginning of the warm temperature storage as well as upon the degree of temperature used. For reasons including the increase in shrinkage, sprouting, decay, and inconvenience, a period of such warm storage cannot be considered a very satisfactory remedy for this condition.

At the present time no satisfactory remedy for dark frying color has been reported. Mere soaking of the potato slices in cold water does not remove the sugar. This does not seem remarkable when we remember that the tuber tissue is still living and the penetrability of the cell membranes to substances in solution is not necessarily altered. The writer has found that an hour or more of soaking in salt solutions will change the permeability so that the sugar is leached out but so are other flavoring materials, leaving a slice which becomes a tasteless chip. The only procedure to be recommended to the commercial chip manufacturer at present is that he buy his potatoes by sample and store them at temperatures not lower than 40°-45° F. until they are used.

While the sugar accumulation due to low temperature storage of potatoes may not so seriously impair palatability when other methods of preparation are used, this is a question which deserves more complete study before farmers are urged to provide storage quarters for potatoes for culinary use where temperatures below 40° F. can be maintained over a long period.

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Some Observations On Long Island's Potato Spray Problem

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Long Island potato growers have probably been spraying potatoes longer and more generally than the growers in any other important potato growing section of this country. Nevertheless at the present time, and for the past three years, they have been very much perplexed, and not a little discouraged as to the results they were securing. At present some question whether spraying pays on the average. Others feel sure that one or another system, if properly carried out, is the thing. Most of them frankly admit that they don't know.

The situation with respect to diseases and insects affected by spraying is as follows: Late blight has been very destructive in two recent years, 1922 and 1928, several other years it has been present and caused some loss. In each of the destructive years gains of 75 to 100 bushels to the acre resulted from good spraying. In this connection it should be noted that for the island as a whole, a blight season, which is always a wet season, is favorable for high potato yields, and consequently the gains from protection against this disease are large. On the other hand a year of severe aphid attack is a dry season, and hence drought may prevent the increases which should have resulted from the larger and longer lived vines obtained from spraying. Understanding of this interrelationship between (1) soil moisture (2) size and length of life of tops as affected by disease and insects, and modified by spraying, and (3) yields, will make clear how spraying results, which on their face appear contradictory, may readily be secured.

A further complicating situation is as follows: The aphids, which are the most common and serious potato insect pest, develop during the first two weeks in July. Late blight also develops during this same period. In some seasons we have conditions so favorable to either one or the other pest that spraying can readily be directed against this pest alone, but quite often both make a good start and it remains for the weather, particularly of the second half of July and August, to determine how destructive either one will be. In 1930 both blight and aphids were present in sufficient amounts the first of July to insure a serious epidemic of either, depending on later weather.

The obvious solution is to recommend, as we have, thorough applications of Bordeaux beginning about June 20, and then supplementary control measures for aphids as these pests develop. It is not possible, of course, to delay the blight sprays until this trouble is generally developed, as we are preventing infection in the case of the disease, and killing the pest after it is established, in the case of the insects. However, in the past eight years disease organisms which attack and kill aphids, and aphid insect parasites, but especially the former, have become more and more efficient in controlling aphids. It is generally said that the aphid diseases will only be a factor in a wet season, but in 1930 they were a factor, and the main factor, in destroying a very heavy aphid infestation in the midst of the most severe drought ever experienced in the memory of the present generation of Long Island farmers. The effect of the blight protecting sprays of Bordeaux was to destroy the aphid disease organism and protect the insects. The earlier and more thorough were these sprays, the more effective the protection, and the more serious the damage from aphids. On July 10, 1930 the unsprayed fields generally were conspicuously more free from aphids, and in better condition than the sprayed. Fortunately for spraying, flea beetles appeared shortly after this and did enough extra damage in the unsprayed fields to even matters, with the results that sprayed and unsprayed fields and experimental plats, averaged about the same yields. Blight was checked by dry weather and was not serious.

The complications of the situation that have been briefly touched upon justify the belief that some very fundamental studies are needed with careful consideration of problems such as:

(1) Distribution of spray applications through the season to determine what times Bordeaux can be most effectively applied for controlling blight and repelling flea bettles; also when heavy applications of spray are desirable. It is easy to avoid these problems by recommending heavy applications at frequent intervals starting as soon as the potatoes are up, as has been done and as has been tried at various times by many growers: but we see no evidence to support the claim that these frequent heavy applications are economical, or even desirable on the average.

(2) Biological control of aphids: We devote much effort to discovering the most efficient methods of controlling harmful diseases, but have yet given little attention to fostering helpful ones. Nicotine is an expensive control for aphids; while aphid diseases may be just as effective. It is not too much to suppose that careful study can develop methods of combatting

aphids by using their diseases, and perhaps growers of the future may be spraying or dusting disease spores for aphid control with less cost, and better effect, than now obtained by nicotine.

Potato Growing in Ireland

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NOTE—The following information on potato growing in Ireland was presented in a letter from John M. Rath of Clogerhead, County Louth, to Dr. Wm. H. Martin. Mr. Rath discusses the methods employed by the best growers in Downs and North Louth, or the Cooley Area, and the older style generally used in Ireland.

The old or general rule is to have the potatoes in land that has given first a crop of barley, laid down to grass for one or two years, ploughed and a crop of oats grown, and then prepared for the potatoes—ploughed in November, if possible. If the weather is suitable, the land is prepared for drilling in the beginning of March; when a fairly fine tilt is obtained the drills are "opened" 29 to 30 inches wide, no matter whether it is light or heavy land (light land is sandy loam, heavy land is the stiff clay soil). The farmyard manure is then carted out and spread in the drills. The seed is dropped 12 inches apart on top of the manure, and as a general rule the seed is all "cut." The drills are then "closed" by the drilling or double plow. These drills are from 10 to 12 inches deep. A plow is used in each furrow or alley then and the tops of the drills harrowed down to allow the "sets" to come up straight and to check weeds, this would be in three weeks or a month according to growth and conditions There is weeding then, and first clay is put to them, and another sod is run in the valleys with the plow or gruber. Lately some of the more advanced growers shake some chemical manure in the alley before the clay is put up to them. Some of them spray, but it is not general except in the real potato districts. One more claying or moulding and they are finished until "lifting" time in November. I may say that one of the causes of not spraying is the large quantity of "Shamrock" potato that is planted and which does not require spraying.

This is the general rule and the area planted by the different farmers or growers would only amount to one or two Irish acres. Where they can get seaweed, as here, they have a different method. The sets are stuck down with a spade in the drills,

or dropped and covered by shoveling, and the seaweed, sometimes whole, and generally mixed with farmyard manure, is put on top and closed up in the ordinary way. Now in Cooley and the Mourne district of Down they have quite a different method. The soil in both countries is "light," very "light" in Down. Their drills are from 22 to 24 inches wide; in Cooley 26 is the rule. In both places artificial manure is used, without anything else. Years ago they used seaweed, and planted boulders on the shore to grow the weed, and took the different lots by auction. Some of the growers even carted stones down from the mountains 9 and 10 miles to the shore for this purpose. Very few of them do it now, but use chemicals instead. They set their seed 14 to 16 inches apart, and instead of closing the whole drill on top of them, they run a plow on the top of each drill and throw in half of it on the sets, covering them with clay to a depth sufficient to protect them from a heavy frost. To do this to suit the subsequent tilling, the drills must be taken in plans of 10, 20, or so; this is called "tipping." The reasons for it are—to enable them to put on the chemical manure without destroying the seed: the few inches of clay saves the seed, and of course they put it on heavy, from 16 cwt. to 18 cwt per Irish acre. The reason why they "tip" in plans is due to the fact that when the potatoes are about to come through the tipping they shake the chemical manure on the drills or the half drills as they are then. To cover it they throw the remaining half drill across on top of the space the seeds are planted in. To have this done evenly when tipping, say you take a plan of ten drills counting the alley or furrow, not the ridge. You walk the horses on the ninth ridge and come back on the first, finishing in the center by doing a bout on one ridge. That is, taking two sods of the one ridge or drill. This leaves the way clear for the covering of the chemical after, as in that operation you start where you finished tipping, and throw the remaining half drills opposite to how they were tipped, as the first half of the 9th ridge was thrown right tipping. Facing same way in the second operation it has its remaining half thrown left. This is called "rising," as it brings back the drills to their first shape and it is great tilling. Generally a lot of weeds have sprung up and the plow cuts them away and smothers them up. To finish the description, it is a case of giving the ground two additional plowings, destroying weeds each time instead of pressing the drill with the double plow which is now used as a tiller. These people run the plow in the alleys and harrow down same as the other men, and carry on the same until lifting time, except that they spray at least twice. The plow going through the alleys takes the place of your cultivator, except it is much slower.

In Cooley the drills are 10 to 12 inches deep. From the first class growers I learn that they have a better result from a manure mixed by Works than by mixing the manures at home. When mixing themselves they put on their Irish acre:

3 cwt. sulphate ammonia.
3 cwt. muriate potash.
8-10 cwt. superphosphate 35% water soluble.

When applying commercial fertilizer they use 14 cwt. to 16 cwt. per acre. This is without manure or seaweed. The Cooley men also "break up" Lea ground, that is, land down to grass for one or two years. In that district which is practically 20% tillage you see very few old Leas, they generally take one meadow and put in potatoes, followed by barley and then go on to potatoes again. They have wonderful yields there, especially of the "Up to Date" and an immune variety, Lochar. It is about the worst potato for table existing, but crops heavily, and they get it away on the English markets except when there is a very large quantity going for sale from Germany and Holland, etc. I know men to have grown 36 tons to the Irish acre; men who gross 16 cwt. to 18 cwt. to the acre of fertilizer. This would be roughly 21 to 22 tons per statute acre. I have not had the time to go over your circulars closely yet, but I see you advocate a decent size seed potato. Here we grade them through 2 inch and over 1¼ to 1½ inch riddles, but I grew a very good crop of all large size tubers from seed through 1¼ and over 1. It is recognized that if you plant small whole seed like these and set them 9 or 10 inches apart you get an earlier potato and a crop of all large table potatoes. The plants generally produce four large tubers. I know I have done it with "Kerrs Pinks" and I had no sorting on them. I think that the fertilizer should be divided in applying, say a small dressing when planting and the remainder when putting first clay to them. I have followed the Cooley methods for five years and I find that it gives better results than the older way and that the "tipping" and "raising" with the plow, together with the time the manure is applied is the reason for it.

To obtain a Certificate of Purity for seed potatoes here the crop must be true to type, free from mosaic, leaf-roll, all black wart, etc. To see that it is done, the growing crop is inspected two or three times by an inspector who sees that all affected plants are removed, tubers and all, and of course that any "rouges" are dug out, to avoid mixing. I always plant a colored variety between two whites, such as Anan Victory between Great Scot and Anan Consul. The A. Victory is purple; a very good main cropper; does well in "heavy" land and very badly in "light." It's big failing is in proneness to mosaic. The

Department is inclined to discourage the growing of it, although they have not moved as yet. G. Scot is a mid-season potato immune and a good valuable variety either to sell early or hold for seed. A. Consul is a new white immune variety, a heavy cropper and a good table potato; it does very slowly at first in growth and appears to lack foilage, but from the middle of July on does very well and throws up plenty of foliage; it resists blight well, but not well enough not to need the usual course of spraying. Speaking of spraying, I see that you prefer the bordeaux mixture; we use the 8 lbs. blue stone or sulphate copper, 10 lbs. soda to 40 gals. water. Some men give the first spraying 4-5-40 and finish with the full strength. Lime was tried but found to clog and stop the nozzles too much.

Notes on Regulations Governing the Importation of Potatoes Into the United States

E. R. SASSCER

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As a precaution against the introduction of the potato wart disease into the United States one of the earliest notices of quarantine, namely, No. 3 (foreign) the Potato Wart Quarantine, was promulgated September 20, 1912, by the newly created Federal Horticultural Board of the United States Department of Agriculture. In effect, this quarantine is an embargo upon the importation of potatoes from countries in which the wart disease was then known to be distributed. These countries are Newfoundland; the islands of St. Pierre and Miquelon; Great Britain, including England, Scotland, Wales, and Ireland; Germany; and Austria Hungary.

The wart disease is caused by the fungous known scientifically as Synchytrium endobioticum. It is one of the most serious and persistent diseases to which the potato is susceptible; in advanced stages it converts the tubers into repulsive warty masses, unrecognizable as potatoes. To make matters worse, the organisms persist for many years in the soil in a living condition, capable of attacking potatoes planted there after the lapse of years. Unfortunately, prior to the promulgation of Quarantine No. 3, the wart disease gained entry into a few isolated localities

in Maryland, West Virginia and Pensylvania, almost exclusively in garden plots planted by miners from stocks of potatoes imported from European countries. The States concerned have maintained rigid quarantines on the infected areas and so far as known have been successful in preventing the spread of the disease from those areas to other parts of the country.

To provide for the complete control of potato importation into this country, and to prevent the further introduction of the wart disease and other dangerous potato diseases and insect pests, the Regulations Governing the Importation of Potatoes into the United States were promulgated under the provisions of the Order of the Secretary of Agriculture of December 22, 1913. These regulations have been revised several times. A copy of the current edition, effective March 1, 1922, with Amendment No. 2, of August 1, 1930, can be procured from the Plant Quarantine and Control Administration, U. S. Department of Agriculture, Washington, D. C.

Regulation 2 sets forth the pre-requisite conditions which must be met by any country as the basis for authorizing the importation into the United States of potatoes from that country. Upon presentation by the authorities of any particular country of evidence, satisfactory to the Secretary of Agriculture, of compliance with the provisions of regulation 2, permits may be issued to importers in the United States for the importation of potatoes from the country in question, subject to compliance, on the part of the importer, with the general body of the potato regulations. Upon the arrival of a consignment of foreign potatoes at a port of the United States, a percentage of the potatoes is subjected to a thorough inspection by inspectors of the Plant Quarantine and Control Administration. The potatoes are admitted only when found free from potato wart and other injurious diseases and insect pests.

Provision is made in regulation 7 of the Potato Regulations for the importation of potatoes from the States of Chihuahua and Sonora, and from the Imperial Valley or Lower California, Mexico, under permit and upon compliance with prescribed conditions. Estonia is the only European country which at present is authorized to export potatoes to the United States under the provisions of the Potato Regulations. Cuba and the Dominican Republic also have met the requirements of regulation 2 and therefore may export potatoes to this country under permit. More recently, the Territory of Porto Rico has qualified under regulation 2 to ship potatoes to the mainland of the United States. Furthermore, provision is made in regulation 7 for the entry of potatoes from the Dominion of Canada and from Bermuda without restriction, except that, in practice, permits are issued for the importation of potatoes from Bermuda.

Crop and Market News

Shipments Heavy; Prices Low

(Contribution From Bureau of Agricultural Economics)

Most striking features of the potato market during late June were the large shipments, the heavy track-holdings in terminal markets, the extremely low prices, and a generally dull situation for this crop.

A few revisions have been made in the forecasts for early potatoes, with increases for Florida, Alabama and the lower valley of Texas but with decreases for many of the second-early States including Maryland and Virginia. The production estimate for North Carolina, the leading shipper in June, was raised to 5,624,000 bushels, while Virginia was reduced to 12,330,000. Total commercial crop in six second-early States is now indicated as 21,396,000 bushels, compared with 22,364.000 in the original forecast. Last year's production in these States was only 19,276,000. Five intermediate States expect 10,691,000, or only slightly more than in 1930. New Jersey looks for 6,270,000 bushels in this total, and Kansas may have 2,467,000, Missouri 931,000 and Kentucky a large crop of 780,000 bushels. Condition of the early potato crop in 10 states on June 1 averaged 81% of normal, or two points higher than in May and 10 points higher than a year ago.

June shipments were much heavier than those of last season, averaging about 6,300 cars each week, or 1,000 more than during the corresponding period in 1930. During the second week of June, almost 6,600 cars were moved, but some decrease occurred after the middle of the month. About the 20th of June, combined track-holdings in 12 large markets were over 1,000 cars. During the week, North Carolina originated nearly 3,000 cars, Virginia 1,115, Oklahoma 500, Texas 375, and California 300. Alabama, Louisiana and Arkansas were credited with 150 to 200 each. Virginia shipments were behind last season's corresponding record, but the State was expected to be shipping heavily before July 1, by which time the North Carolina crop will be out of the way.

By June 23, f. o. b. prices in the East had dropped to a very discouraging level. Barrels of best Cobblers were returning only $1.45-$1.50 in North Carolina and only $1.75 on Eastern Shore of Virginia. At the same time in 1930, an f. o. b. range of $3.50-$3.75 prevailed. Cash-track prices of sacked Bliss Triumphs in Oklahoma and Arkansas were recently 75c-85c per 100 pounds, with usual-terms sales as high as $1. Haulings were at their height in Arkansas and Oklahoma. Shipments were expected to begin soon from Kansas, Missouri and other central sections.

City dealers during the last week of June quoted jobbing sales of best North Carolina Cobblers at $1.75-$2.60, with Virginia stock ranging up to $3 per barrel. South Central sacked Bliss Triumphs ranged mostly $1.25-$1.75 per 100 pounds. The season for old potatoes was about finished, but a few city sales of Maine Green Mountains were still reported at $1.75-$2.10 per 100 pounds. This is in contrast with "futures" sales of Green Mountains for delivery in Boston during October at $1.08. Chicago "futures" on Idaho Russet Burbanks were averaging $1.45 and Round Whites 95c per 100 pounds.

Crop and Market News

Notes on the 1930-31 Idaho Potato Deal

Over 32,600 cars of potatoes were shipped from Idaho this past year. This is a crop exceeding by 4,295 cars the previous record of 1927. The freeze in the fall of 1930 is estimated to have reduced Idaho's available shipping potatoes by several thousand cars.

Forty-two per cent more potatoes were produced in Idaho in 1930-31 than in the previous crop year.

The average yield per acre in 1930-31 was 214 bushels as compared with 168 bushels in 1929-30.

No. 2 potatoes are estimated to have made up between 40 per cent and 45 per cent of the shipments from Idaho this past season.

The small-bag business is on the increase in Idaho. Estimates show that 15 per cent to 20 per cent of the potatoes marketed in 1930-31 were sold in 15-pound and 25-pound bags.

A light volume of washed potatoes was shipped this season. It brought a premium over other fancy packs.

No. 2 potatoes and culls will probably pay best in 1931-32 as livestock feed. Make preparation now for feeding low-grade potatoes on the farm.—H. E. Drobish.

Chicago Mercantile Exchange

The Chicago Mercantile Exchange will inaugurate its own ticker service beginning June 1. The service will be placed in operation from Chicago to Cleveland, Philadelphia, Pittsburgh, New York City, Newark, N. J., Brooklyn and Boston, later being extended to other cities.

The exchange has not had a service in the past which would enable the eastern brokerage houses to obtain instantaneous quotations from the floor of the Exchange. In addition to posting the sales, bids and offers on the futures contracts of butter, eggs and potatoes, a considerable volume of statistical informa-

tion relating to spot markets, storage movements and so on will be assembled from various parts of the country for transmission.

The service will be over narrow tape teletype machines on American Telephone and Telegraph Company lines.

Within a short time, the service will be extended to Baltimore, Washington, Buffalo, Detroit and a number of other eastern cities, later being moved westward to Milwaukee, St. Louis, Kansas City, Des Moines, Omaha, Minneapolis and St. Paul, Mr. Field said.

The wire will operate from 9:15 a. m. to 12:15 p. m. Chicago time, extending from 15 minutes before the call until 15 minutes after the call.

Announcement of Meetings

Empire State Potato club summer meeting and field day at the farm of George W. Lamb, Hubbardsville, N. Y., July 29.

Pennsylvania State Potato Growers' convention at State College, Pa., August 24-26.

Ohio Potato Day

The Ohio Experiment Station at Wooster is holding Potato Day August 20. Interest in potatoes runs high in Ohio because the crops requires special care to be profitable, and Ohio remains a deficiency state. An extensive series of experiments on culture are in progress at the Station.—John Bushnell.

Review of Recent Literature

Gratz, L. O. Potato Spraying and Dusting Experiments in Florida, 1920 to 1929. Florida Agr. Exp. Sta. Bul. 222:1-39, November 1930.

Experiments to compare Bordo spray (4-4-50) with copper-lime dust (20-80) were carried on with the cooperation of a large grower in the Hastings section over a six-year period. A three-row traction sprayer and a three-row traction duster were used. In general, sprayed lands gave greater yields than dusted lands and dusted lands gave greater yields than the checks. Sprayed foliage remained green about 10 to 14 days longer than dusted foliage while dusted foliage remained green 10 days longer than the checks. When equivalent amounts per acre of metallic copper were applied, differences in yield between the sprayed and the dusted plots could not always be demonstrated. Spraying and dusting costs were estimated to be $1.44 and $1.88 per application per acre respectively. This shows an increased cost for five aplications of dusting over spraying of $2.20 per acre

per season and indicates that spraying ordinarily can be expected to yield greater profits than dusting.—E. V. H.

Huckett, H. C. Spraying and Dusting Experiments with Potatoes on Long Island. New York State Agr. Exp. Sta. Bul. 592: 1-38, February 1931.

The author reports results of spraying and dusting experiments on Long Island for the five-year period 1926-30. With Irish Cobbler, in five tests at Riverhead, only one showed a profitable increase in yield from continuous treatment. There was no significant difference in the results from spraying and dusting. In the dry season of 1929, although the sprayed foliage was noticeable better than the dusted foliage, yields from the latter were somewhat superior. Nicotine treatments for the control of aphids, in either spray or dust forms, did not give increases in yield over those from the usual spraying or dusting operations.

With Green Mountain, of 10 tests made at Riverhead only five gave profitable yield increases. Copper treatments in spray form averaged results somewhat superior to copper treatments in dust form. Nicotine treatments in dust form gave better aphis control than nicotine treatments in spray form. Nothing was gained by making heavier applications of spray by means of a four-row boom with three nozzles per row as compared with applications by means of a six-row boom with two nozzles per row.—E. V. H.

Stewart, F. C. and **Glasgow, Hugh.** Aphids as Vectors of Leafroll Among Sprouting Potato Tubers. New York Agr. Exp. Sta. Technical Bul. 171:1-21, December 1930.

Announcement is made of the discovery of aphids (Myzus persicae Sulz.) on sprouting potato tubers in New York. Altho this phenomenon is frequent in England and Ireland, it has been reported but once previously from America. Apparently the planting of infested tubers killed the aphids as none could be found on the aerial parts of the plants. The results of infection experiments show that aphids may spread leafroll freely among sprouting seed potatoes. Pronounced leafroll symptoms appeared within 35 days after planting. If one-half of an uncut healthy sprouting tuber is exposed for a few days to viruliferous aphids, and the other half closely covered to protect it from aphids, pieces of the former, when planted, will produce leafroll plants, while pieces of the latter will produce healthy plants. It was shown by experiment that fumigation with either tobacco powder or sodium cyanide will rid seed potatoes of aphids without injury to the tubers. The recommendation is made that seed potatoes which sprout before planting time be examined for aphids.—E. V. H.